EFFECTS OF BAUXITE ON PENTAERYTHRITOL AND EXPANDABLE GRAPHITE BASED INTUMESCENT COATING

Adiat Ibironke Arogundade, Puteri Sri Melor Megat Yusoff, Faiz Ahmad

Introduction

In this chapter, a comparison study has been conducted between pentaerythritol and expandable graphite. The results showed that the intumescent action of a chemically reactive system, PER-APP, is negatively affected by the presence of bauxite residue, a hydroxide mineral waste used as an alternative filler. This is adduced to the interference of the hydroxide minerals with the intumescent action as they react with APP to form metal phosphates, thereby leading to a shortage of phosphate ions for the esterification of PER. Char expansion reduced from 18.3 times to 1.2 times with fully propagated cracks and partial separation from the steel plate. In contrast, the same filler reinforced the physically reactive system, EG-APP-BR, without adverse effect on char expansion. The char had a hard consistency with no noticeable cracks and good adhesion to the steel plate. The degree of char expansion reduced slightly from 6.12 to 4.55 times. Thus, physically reactive intumescent systems may be described as less selective in the choice of reinforcing additives.

Introduction to Fire-fighting Techniques

Controlled fire-fighting is an age-old science dating back to ancient Egypt. The first recorded fire-fighting exercises described water pumps and other fire-fighting machinery in the active fighting of city-based

fires [1]. Active fire-fighting is on the spot, manual or automated response to fire, involving men's mobility or activated devices. Dynamic response to fire could be in the form of fire-fighting men and their sprinkler systems, or this could be a network of automated pipes, smoke detectors, and sprinkler systems built into the walls and ceilings of the buildings [2]. While automated systems may sometimes fail and often leave lots of mess and clean-up in their wake, the rapidity with which fire spreads and develops calls for other forms of backup. The best practice in most countries is the augmentation of active fire-fighting with passive fire-fighting techniques. It is often mandatory for public places like hospitals, shopping malls, hotels, and eateries to have one form of the passive fire-protective system in place.

Passive fire-fighting methods are fire-fighting approaches in which fire-retardant materials are used to construct and produce buildings, textiles, and furniture items to reduce the occurrence and spread of fire. Most residential fires start from electrical faults, lighted candles, partially-scorched cigarette butts, etc. The first victims of such fires are the easily ignited, flammable furniture items, such as polymer-based electronic gadgets, curtains, chairs, and bedding fabrics. In recent years, fire passivation of these items has been achieved through the inherent and subtle modification of material properties. Rather than burning, such fire retardant items would char, leading to the prevention of many would-be fire accidents. Such an approach is the intumescent fire-retardant systems.

Intumescent Fire-fighting Methods

Intumesce is a Greek word that means to swell. Intumescence is ascribed to a group of passive fire retardant systems that employ a swollen insulating barrier to drastically reduce heat and gaseous energy transfer to and from the burning material [3]. In recent years, intumescing fire retardant systems have become quite popular, especially in the construction industry, due to their many advantages. Unlike the traditional, non-reactive fire protection methods for structural systems such as cementitious, mortar coatings, and insulative boards, intumescent coatings are light, easy to apply, aesthetic, and do not take up space. Intumescence may occur either by a chemical reaction between two or several agents or by the physical expansion of an inherently intumescent material [4]. Reactive, passive fire-fighting mainly uses chemically reactive additives, which decompose upon exposure to a heat source, resulting in gases that hinder ignition. Though